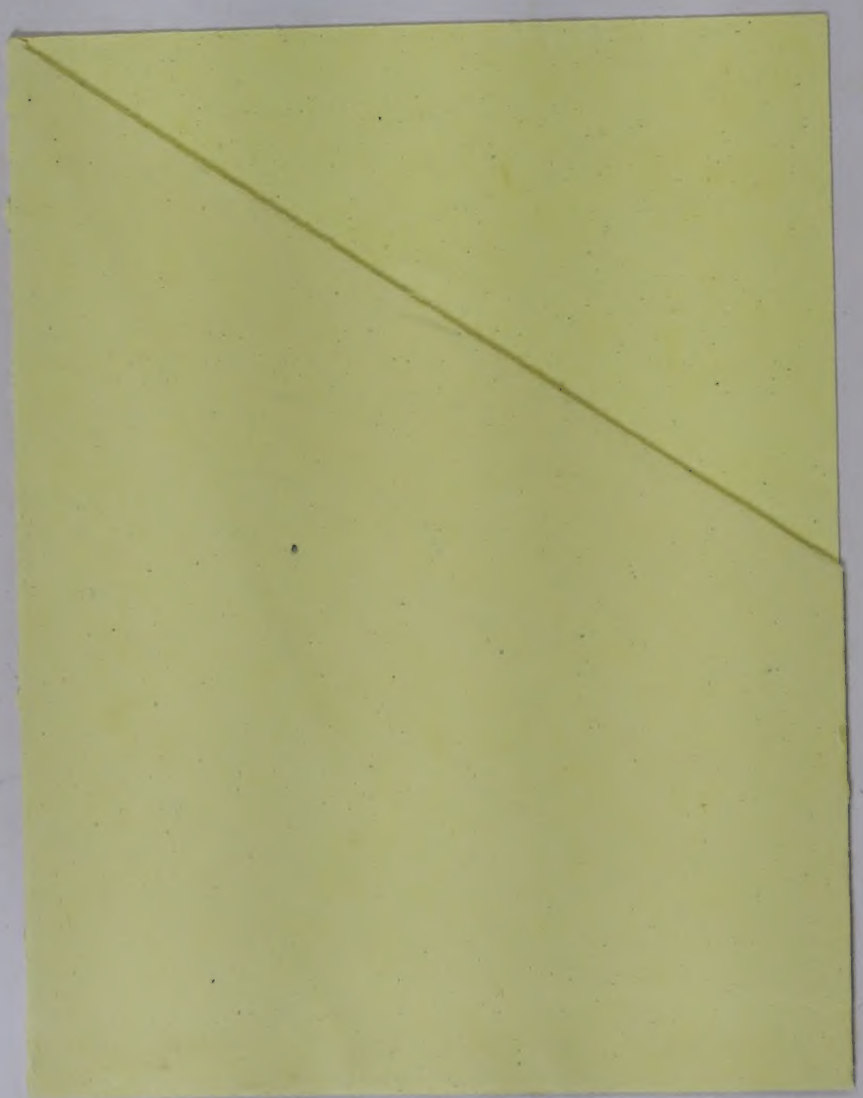
EXTENSION BULLETIN NO. 25

Pest Control in Horticultural Crops

INDIAN INSTITUTE OF HORTICULTURAL RESEARCH,
BANGALORE—560080 (Karnataka)



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Pest Control in Horticultural Crops

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PEST CONTROL IN HORTICULTURAL CROPS

Fruits and Vegetables play an important role in human nutrition. They provide Proteins, Carbohydrates, Vitamins, minerals and roughage which constitute the essentials of a balanced diet. Pest problems figure out among the major constraints to horticultural production. It is also well known that the problems due to pests are accentuated with the intensification of cultural practices and no crop can successfully be grown without a pesticide umberlla. Fruit crops being of perennial nature, harbour and encourage the pest populations throughout the year. Fruitflies and borers survive all round the year by the support of alternate host plants which bear in different seasons. The problem of pests carry over is relatively more in horticultural crops. At times fruits become malformed and unmarketable. Hence control measures become necessary. Recommendations for the control of pests viz., insects, mites and nematodes are incorporated below.

Fruit Crops

MANGO

Mango hoppers (*Idioscopus* spp.)

Description : The adults are small, grey, dark coloured insects. This is a major pest and almost all varieties of mango are attacked.

Nature of damage : Both nymphs and adults suck the sap from tender shoots, leaves and inflorescence resulting in wilting and drying of these plant parts. In case of severe infestation, there may be a total failure of the crop. Sweet sticky substance exuded by hoppers covers whole shoots and foliage, giving a glazed and shiny appearance which indicates presence of this pest in an orchard. This honey dew also encourages the growth of black sooty mould on foliage which hinders photosynthesis. The peak activity is confined to flowering season and the loss ranges from 25 to 60 per cent. The pest is commonly known as "Madhua" in Northern India.

Distribution : This pest is widely distributed and is reported from many parts of our country.

Fig. 1. Damage by hoppers

Control : This pest can be effectively controlled by 2–3 sprays of carbaryl (Sevin or Kilex Carbaryl 50% W.P. at 4 gms per litre of water) at 21 day intervals. Alternatively, monocrotophos 0.05% (Nuvacron 40 E.C. at 1.25 ml per litre), phenthoate 0.05% (Phendal or Elsan 50 E.C. at 1 ml per litre) or malathion 0.1% (Cythion 50 E.C. at 2 ml per litre of water) may be sprayed. Spraying should commence at initiation of panicle emergence and repeated after 3 weeks.

Mealy Bug (*Drosicha stebbingi* Green)

Description : The adult female bugs are flat, oval, waxy white and measure 12–16 mm in size.

Nature of damage : The eggs are laid in soil. Small pinkish first instar nymphs start hatching in the last week of December and migrate to mango trees. Both nymphs and adult females suck sap from tender shoots and inflorescence resulting in drying of inflorescence and loss in fruit set.

Distribution : It is widely distributed all along the Indo-Gangetic plains of Northern India. It is popularly known as 'Lahi' or giant mealy bug.

Control : Removal of Weeds like Bhatter (*Clerodendrum inflortunatum* and other grasses from the orchards and ploughing of soil during November is recommended. In the third week of December in order to kill newly hatched nymphs, 250 gm of aldrin 5% dust should be dusted with hand rotary duster from 30 cm above ground level under the tree in drip circle and then the soil should be raked to ensure that no drift falls on human beings.

In case of drenching, add 10 ml of aldrin 30 EC per litre of water and prepare about 20 litre emulsion. With the help of water can apply the emulsion to soil around the tree trunk. In the middle of December banding the trees with 20 cm wide Alkathene/polythene (400 guage) is to be undertaken. Apply a little mud or fruit tree grease on the lower edge of the band after tying with jute thread to stick it to stem and ensure that the bugs may not climb the tree beneath the band. Banding should be done 2–3 ft above the ground level and just below the junction of branching on all the trees in the orchard, including other fruit trees like guava, jack fruit and citrus. In case bugs have already migrated in the month of January, spray diazinon 0.06% (Basudin 20 EC at 3 ml per litre) or monocrotophos 0.04% (Nuvacron 1 ml per litre of water). The spray may be repeated if necessary. Avoid spraying during full bloom period.

Oriental Fruitfly (*Dacus dorsalis* Hendel)

Nature of damage : Fruitflies cause serious loss to mango crop by rendering the fruits unfit for human consumption. The attack of pest starts when the fruits are about to ripen. Maggots after hatching feed on the pulp, fruits drop and start rotting from inside. On complete rotting of the fruits, the maggots come out and pupate in the soil. The damaged fruits have yellow spots with black centres through which liquid oozes out on pressing.

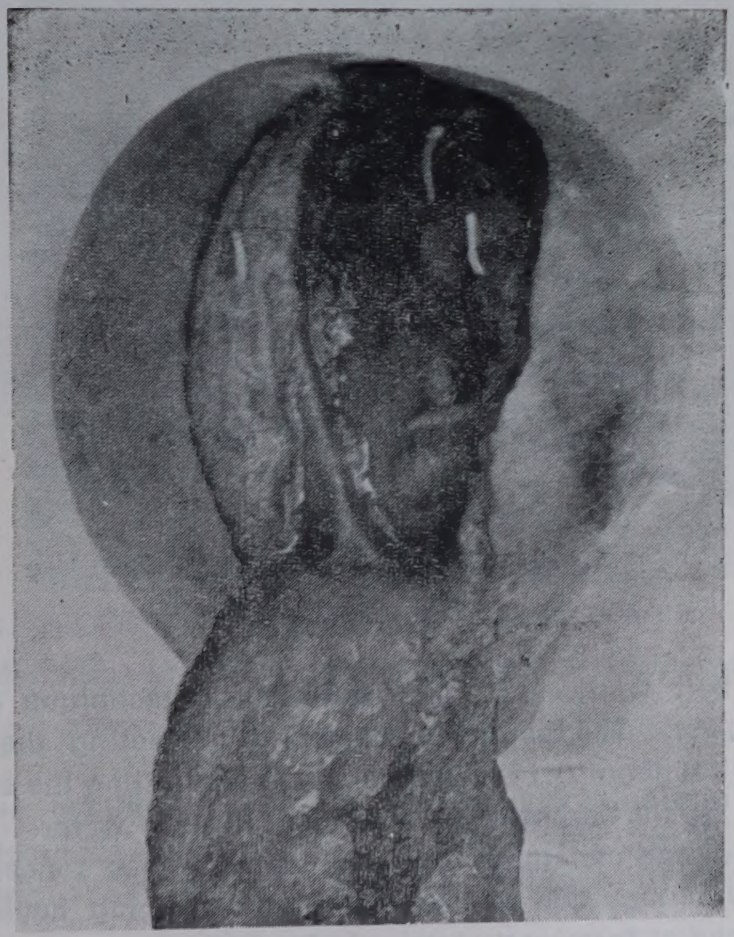

Fig. 2 Damage by fruitfly

Distribution : The pest is active throughout the year in South India while in North it hibernates during November to March in pupal stage. Maximum damage to the fruits is done in June—July and late varieties are most susceptible to this pest.

Control : The soil should be raked up in summer months in order to expose pupae to sun, parasites and predators. Bait spray with malathion (Cythion 50 EC @ 1 ml per litre) or carbaryl (Sevin 50% W.P. @ 4 gm per litre) or dimethoate (Rogor 30 EC 1 ml per litre) in combination with molasses or jaggery (10 gms per litre of water) should be given twice at fortnightly intervals before ripening of the fruits, During ripening stage of fruits, the fallen fruits should be dumped in a pit of 6'×4'×4' and covered with a thick layer of soil.

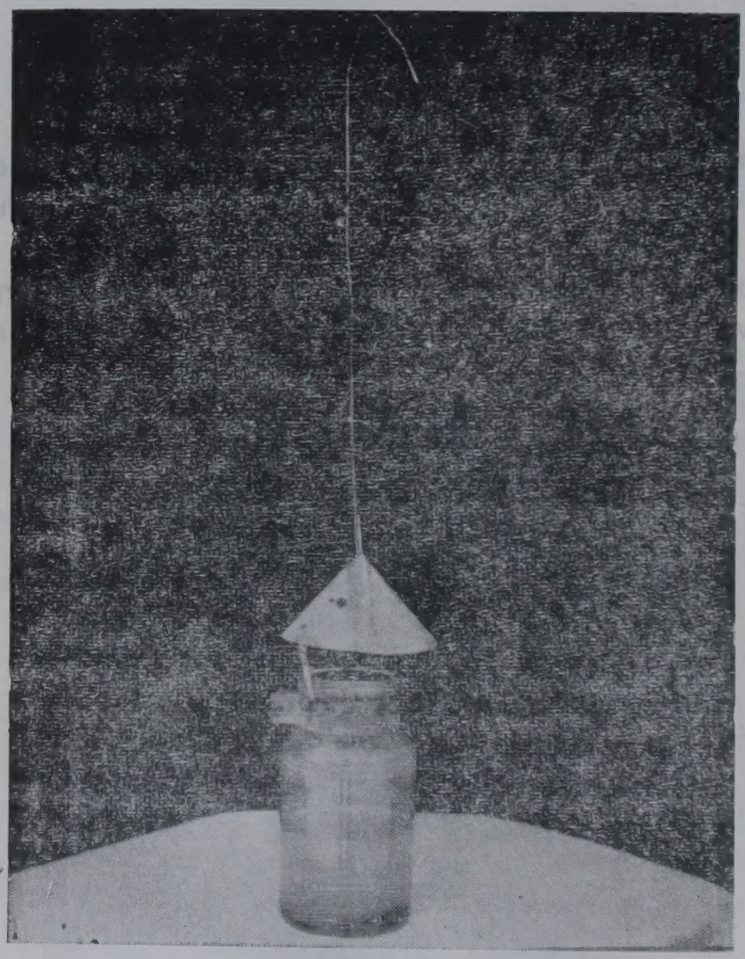

Fig. 3. Fruitfly trap

A combination of bait sprays and male annihilation technique should be used for effective control of the pest. The technique consists of attracting the male fruitflies in a trap (Fig. 3) with methyl eugenol 0.1% (1 ml per litre) and killing the same with the aid of malathion 50 EC added to the solution at 2 ml per litre of water. 100 ml of solution containing methyl eugenol and malathion at the adove mentioned concentrations should be put in 250 ml capacity wide mouthed bottles fitted with hanging device at its neck. The solution should be changed at fortnightly intervals from March to July.

BANANA

Rhizome Weevil (*Cosmopolites sordidus* G.)

Nature of damage : It is a major pest of banana and the larva after hatching feeds on leaf sheath and tunnels into the sucker. Consequently, the plant becomes weak and breaks from the place of infestation. The beetles are weak fliers and remain in soil within the root zone. High incidence of the pest occurs during April to October.

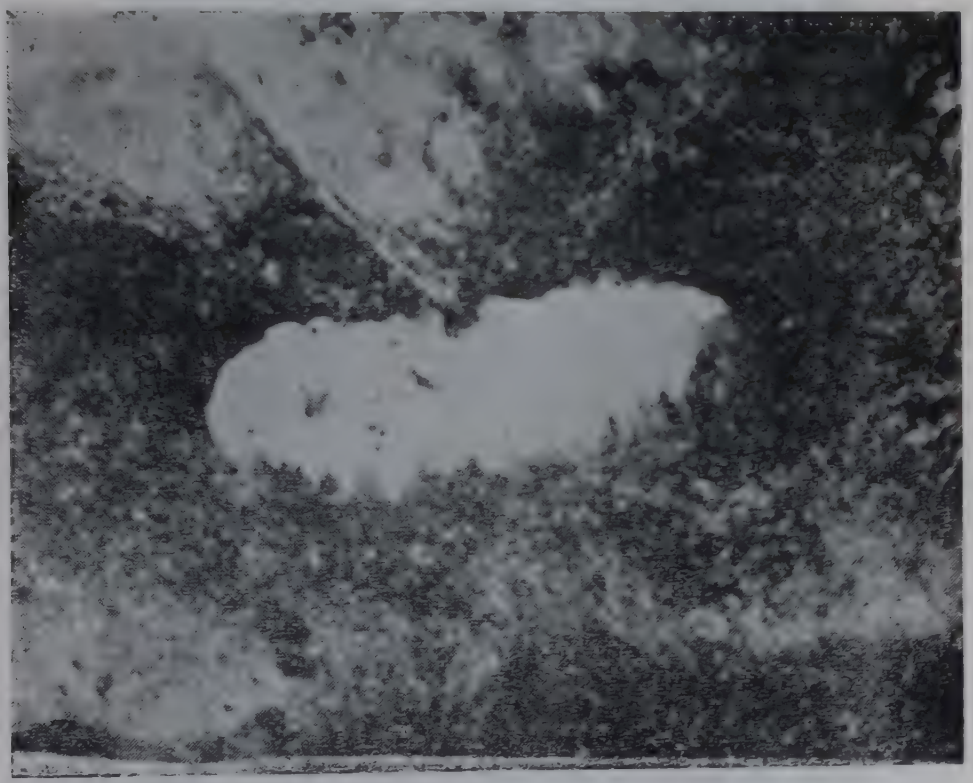

Fig. 4. Damage by Rhizome Weevil

Distribution : It causes severe damage in Assam, Kerala, Tamil Nadu, Karnataka and Maharashtra. 'Malbhog' and 'Champa' are the most preferred varieties.

Control : Plant healthy suckers after dipping in 0.1% aldrin or dieldrin emulsion. Apply 60 gm of dieldrin 5% dust or 100 gm of BHC 10% dust or incorporate 10 gm of carbofuran (Furadan) 3 G or 5 gm of phorate (Thimet) 10 G per pit at the time of planting.

Pseudostem borer (*Odoiporus longicollis* Oliv.)

Nature of damage : The grubs make longitudinal tunnels in pseudostem. Small holes with characteristic brownish boundary are visible on the surface of affected plants upto a height of 6 feet. In cases of severe infestation, pseudostem becomes pale and plants get stunted. The pest is confined to banana and is active during summer and monsoon months.

Fig. 5. Damage by pseudostem borer.

Distribution : It is commonly found in Bihar and Assam. It has also been reported from Delhi and Uttar Pradesh.

Control : Spray the base of plants with BHC 0.3% or parathion 0.1% or dieldrin 0.2% @ 250–300 litres solution per acre.

Banana aphid (*Pentalonia nigronervosa* Cog.)

Nature of damage : The aphids are grey or black in colour and reduce the vitality of the plant by continuous desapping. They also act as a vector of banana mosaic and bunchy top diseases.

Control : Spray dimethoate 0.05% (Rogor 30 E.C. 1.5 ml/litre) or demeton methyl 0.05% (Metasystox 25 E.C. 2 ml/litre of water) or phosphamidon 0.05% (Dimecron 100 EC 0.5 ml/litre of water) or monocrotophos 0.04% (Nuvacron 40 E.C. 1 ml/litre of water).

POMEGRANATE

Anar butterfly (*Virachola isocrates* F.)

This is a major pest causing severe loss to fruits. The adult is a large brownish butterfly. The larvae bore into the fruits and feed on the pulp and seed. The entrance hole on the fruit cannot be easily noticed. Presence of frass on the surface indicates the presence of larvae inside the fruits.

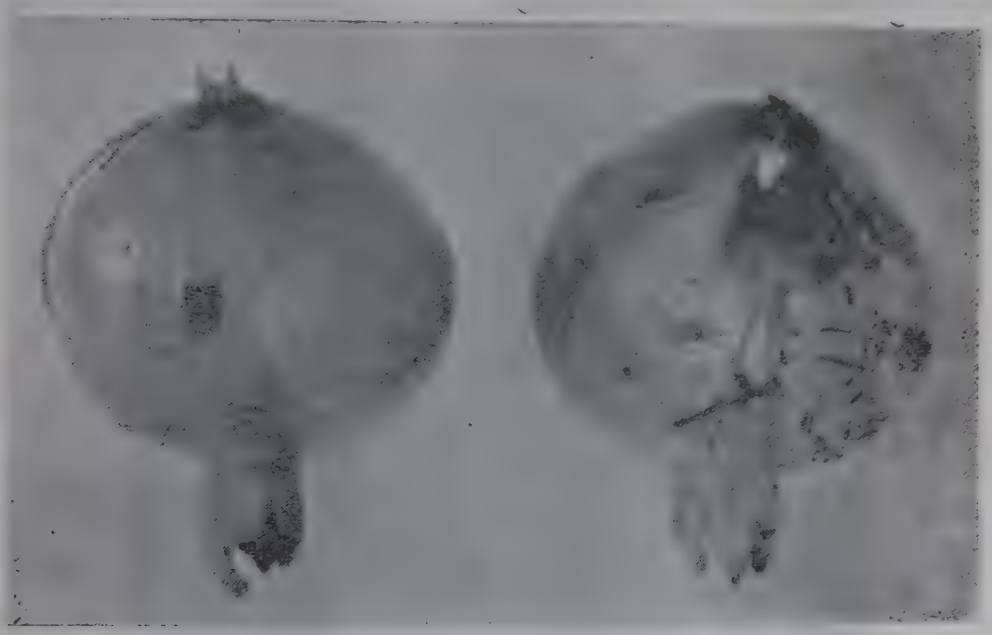

Fig. 6. Fruits showing exit holes.

Control : Spray young fruits with methyl parathion 0.05% (Metacid 50 E.C. 1 ml/litre) or carbaryl 0.2% (Sevin 50% W.P. 4 gm/litre) or phosphamidon 0.03% (Dimecron 100 E.C. 0.3 ml/litre of water) at fortnightly intervals.

CUSTARD APPLE

Mealy bug (*Ferrisiana virgata* Cockerell and *Pseudococcus lilacinus* Cockerel L)

The fruit is commonly called Sitaphal or Sharifa. The above pest is widely found throughout custard apple growing areas of the country. These are small soft bodied insects

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with mealy wax secretion. Both nymphs and adult females suck the sap from leaves, shoots, buds and fruits. In case of severe infestation, the affected fruits become deformed and lose their market value. Besides, they exude copious amount of honey dew on which black sooty mould develops thereby interfering with photosynthetic activity of the trees. The pest is found throughout the year but the maximum activity is during March—April. With the onset of Monsoon, the activity is decreased and again the activity is accelerated after the rains.

Control: Spray malathion 0.05% (Malathion 50 EC 1 ml/litre of water) or phosphamidon 0.03% (Dimecron 100 EC 0.3 ml/litre of water) or diazinon 0.1% (Basudin 20 EC 5 ml/litre of water) or monocrotophos 0.05% (Nuvacron 40 EC 1.25 ml/litre of water).

PINEAPPLE

Mealy bug (*Pseudococcus brevipes* Ckll.)

They occur in colonies on leaves and fruits and suck the sap continuously and devitalize the plants. They are small reddish insects having a white waxy covering with tassels on them. It is found in all pineapple growing areas and causes wilt.

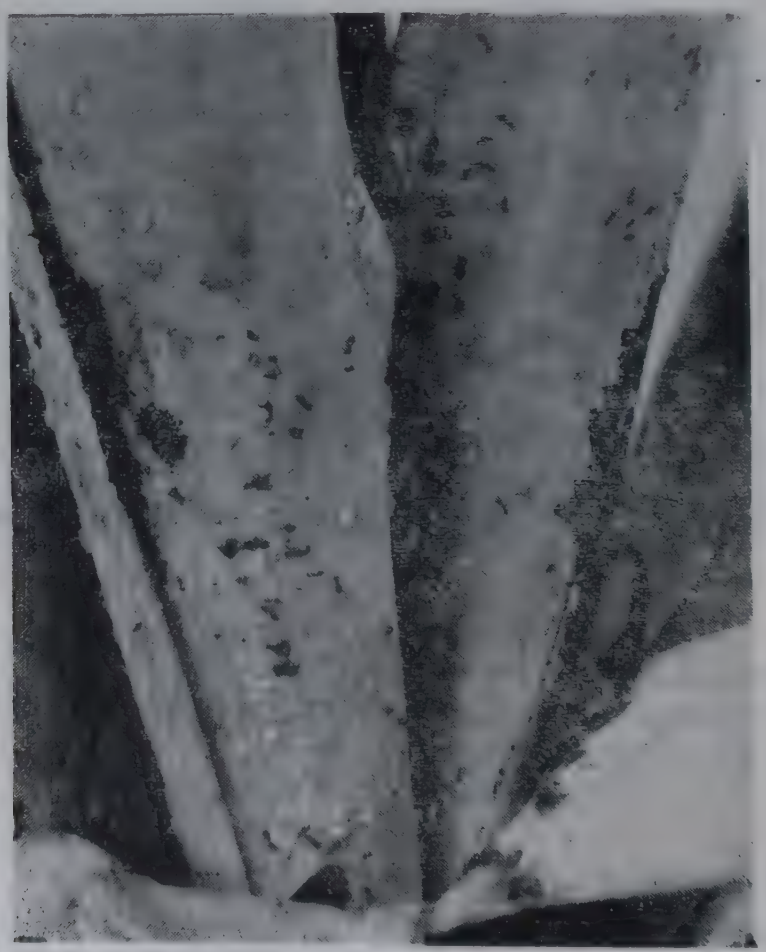

Fig. 7. Mealy bugs on leaves

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Control : Use healthy suckers for planting or dip the suckers in 0.1% methyl parathion or 0.1% diazinon solution. Phorate granules (Thimet 10 G 1.75 kg a.i./ha), can also be applied at 100 day intervals from the time of planting.

GUAVA

Fruitfly (*Dacus dorsalis* Hendel)

It is found all over India but is more serious in Uttar Pradesh. Rainy season crop is more affected than winter season crop. Dark greenish punctures on the surface of the fruit indicates the infestation of this pest. For the nature of damage and control refer under mango fruitfly mentioned earlier.

Coccid (*Pulvinaria psidii* Maskell)

These are found all over India but are more pronounced in Uttar Pradesh, Bihar, Punjab and Maharashtra. These are white soft insects which cause damage to leaves and shoots by desapping.

Control : Spray diazinon 0.05% (Basudin 20 E.C. at 2.5 ml/litre of water, or monocrotophos 0.05% (Nuvacron 40 E.C. at 1.25 ml/litre of water).

Mealy bug : Refer under mango.

GRAPES

Flea beetle (*Scelodonta strigicollis* M.)

It is a serious pest specific to grapes and is widely distributed all over India. It causes comparatively more loss in South India, Maharashtra, Gujarat and Rajasthan. The adult beetle feeds on emerging buds and young leaves by cutting holes and as a result leaves show punctured appearance. It also attacks tendrils and scrapes the young berries. Grubs feed on roots. The pest is more active during September—December and again during March—May in South India, while in Punjab, Haryana and Himachal Pradesh it appears from March—November.

Control : Remove the loose bark at the time of pruning which prevents beetles from egg laying. Spray parathion 0.05% (Metacid 50 E.C. 1 ml/litre of water) or quinalphos 0.05% (Ekalux 25 E.C. 2 ml/litre of water).

Thrips (*Rhipiphorothrips cruentatus* Hood)

It is a widely distributed pest through out grape growing areas of the country. It starts damaging the vines soon after pruning when the plant bears new vegetative flush.

The insects scrape the epidermis and suck the oozing sap. Infested patches are white and later turn brown. In severe cases leaves curl up, wither and dry off prematurely. Scraping of young berries results in formation of corky crust or scab. The peak infestation is during hot weather.

Control : The pest can be easily controlled by spraying monocrotophos 0.05% (Nuvacron 1.25 ml/litre of water) of dimethoate 0.05 % (Rogor 1.7 ml/litre of water).

Spider mites (*Paratetranychus punicae*)

It is a sporadic pest on grapes but sometimes infestation is severe. The adults and nymphs suck the sap from leaves. Badly affected leaves show a peculiar bronzy appearance and ultimately wither and dry.

Control : Spray dicofol 0.04% (Kelthane at 2.2 ml/litre of water) or monocrotophos 0.05% (Nuvacron 1.25 ml/litre of water).

Grape mealy bug : (*Pseudococcus carymbatus* Green)

These are small soft bodied insects and are polyphagous in their feeding habit. Although sporadic in nature, it has assumed its significance in grape growing are as of Andhra Pradesh. Both nymphs and adult females suck the sap from leaves, shoots and berries thereby weakening the vigour of the vines. The affected berries lose their market value. Exudation of honey dew favours the growth of black sooty mould which hinders the photosynthetic activity of the plant. The infestation is serious during bearing of the plants.

Control : Spray dichlorvos 0.15%+fish oil rosin soap 2.5% (Nuvan 100 EC 1.5 ml + fish oil rosin soap 25 gm/litre of water) or monocrotophos 0.06% + Agricultural Spray oil 1% (Nuvacron 40 Ec 1.5 ml + Agricultural spray oil 10 ml/litre of water). The pest can also be effectively controlled by fortnightly sprays of phosphamidon 0.03% (Dimecron 0.3 ml per litre).

BER

Fruit fly (*Carpomyia vesuvaina* Costa)

It is widely distributed all over India. It is monophagous and is active during the winter months. Maggots feed and grow within the fruits. Affected fruits become unfit for consumption.

Control : Spray carbaryl 0.2% (Sevin 50% W/P 4 gm/litre of water) or malathion 0.1% (Malathion 50 E.C. 2 ml per litre of water) at fortnightly intervals during the fruiting period. Observe a gap of seven days between spraying and harvesting.

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LITCHI

Mite (*Aceria litchi* Kiefer)

It is a serious pest and is distributed practically all over the country. But its incidence is severe in North Bihar and Karnataka. The maximum activity of the pest is during April–May and again in September–October. It lacerates the tissues and desaps the leaves and young fruits resulting in brownish velvety growth giving leathery appearance on the underside of leaves. The leaves become curly and growth of the plant is retarded, ultimately affecting the yield.

Fig. 8. Damage by Litchi mite

Control : Trimming of affected portions, followed by spray of dicofol 0.025% (Kelthane 1.5 ml per litre of water) or dimethoate 0.06% (Rogor 30 E.C. 2 ml/litre of water) at monthly intervals controls litchi mite.

CITRUS

More than 120 species of insect pests attack citrus in India. In Kodagu, over 50 species of insect and mite pests have been recorded causing considerable damage. The chemical control measures for the insects which play an important role causing direct or indirect losses to citrus orchards are discussed below :

1. Soft green scale (*Coccus viridis* (Green) Fig. 9). The adult female is pale green, ovate, slightly convex and measures about 3 mm in length. Female gives birth to 300 to 500 young ones, and these young ones (crawlers) usually settle on tender leaves, twigs and fruits, attaining maturity in 4 to 5 weeks time. Adult females live for 2–3 months and there are 4 overlapping generations.

These scale insects suck plant sap resulting in defoliation and drying of twigs. They also secrete large quantity of honey dew. Sooty mould develops on this secretion, which checks photosynthetic activity of the plant.

1. Healthy leaf.
2. Infested leaf.
3. Sooty mould covered leaf.

Fig. 9. Soft green scale

This pest can be effectively controlled by two sprays of methyl parathion (0.075%), malathion (0.1%), chlorfenvinpos (0.05%), quinalphos (0.05%), methomyl (0.05%), methidathion (0.05%), phenthoate (0.1%), carbaryl (0.2%), fish oil insecticidal soap (4%), chlorfenvinphos (0.025%) + fish oil insecticidal soap (2%) or methyl parathion (0.0375%), + fish oil insecticidal soap (2%) at weekly interval. Any one of these insecticides or a single application of systemic insecticide monocrotophos (0.1%) can also effectively control this pest. In endemic areas spraying should be taken up before and after the rainy season.

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Fig. 10. Brown Scale

2. Brown scale (*Saissetia coffeae* (Walker)) (Fig.10) : The adult female of brown scale is red brown to dark brown in colour with smooth and shining surface, more or less hemispherical in profile, short, oval in contour, measuring 2–3 mm long and 1.5–2.0 mm broad. The eggs hatch inside the body of the female and after sometime crawlers start emerging from the underside. The other behaviour is more or less same as that of soft green scale. Effective control of brown scale is achieved by two sprays of carbaryl (0.2%) or methomyl (0.075%) at 10 days interval.

Two species of hard scales i.e. the purple scale, (*Lepidosaphes beckii* (Newm)) and Florida red scale, (*Chrysomphalus aonidium* (L.)) sometimes cause serious damage. Measures taken for the control of soft green scale help in checking the multiplication of these hard scales.

3. Citrus mealybug (*Planococcus citri* (Risso)) : The citrus mealy bug breeds continuously. Adult female is slightly elongate, ovate, flattened, light brown with short spines projecting from the body margin and posterior end of the abdomen, measuring 3 to 4 mm in length. Their bodies are covered with dense white mealy waxy secretion except at the articulation of the segments. Yellow eggs are produced in a loose cottony mass of waxy filaments which covers most of the female at the time of egg laying. In about a fortnight 600 to 800 eggs are deposited. Eggs hatch in about 7 to 15 days and the tiny brownish yellow nymphs start migrating and settling over the suitable plant parts. The female nymphs moult three times and the male four times. In the field there are about 3 overlapping generations in a year. The pest prefers to feed on the stalks of fruits resulting in their drop.

The chemicals recommended for the control of soft green scale temporarily suppress the population of this pest. A significant biological control method for this pest has been evolved at Horticultural Experiment Station, Chethalli which is now widely used in this area.

Another mealy bug (*Pseudococcus citriculus*) has frequently been recorded in Kodagu The biology and control of this pest are more or less similar to citrus mealy bug.

Orange spiny white fly, (*Aleurocanthus spiniferus* (Quaintance)), citrus black fly, (*A. woglumi* Ashby) and citrus whitefly, (*Dialeurodes citri* (Ashmead)) are normally controlled by the same insecticides used for the control of soft green scale.

4. Spirea aphid (*Aphis citricola* v. der Goot) : The life cycle of spirea aphid is completed in about six days. The females become reproductive in 4 to 16 days and have capacity to give birth upto 100 young ones within 2 to 4 weeks of their life time. Alate or winged forms migrate to the tender flushes and sometimes carried away to distant orchards by wind.

Fig. 11. Black citrus aphid

5. Black citrus aphid (*Toxoptera aurantii* (B. de F.)) (Fig. 11) : The black citrus aphid produces about 5 young ones daily for a period of one to three weeks. The nymphs are brown in colour and attain maturity in about six days. Apart from feeding on succulent leaves this aphid also feeds on flowers. *T. citricidus* has similar life cycle.

For the control of aphids, oxydemeton methyl (0.025%) or monocrotophos (0.025%) have proved highly effective during flushing seasons.

Fig. 12. Citrus leaf ∝ miner

6. Citrus leafminer (*Phyllocnistis citrella* Staint.) (Fig. 12) : It is a serious pest of nurseries, young plants, and tender flushes of the grown up plants. The larvae usually mine the underside of the leaves making serpentine mines, which are silver coloured due to entrapped air. Due to extensive mining by the larvae, the leaves get badly distorted, irregularly curled up, and in case of twig attack, 'die-back' has been observed frequently.

The adult is tiny silvery white moth with yellowish markings and a black spot near the tip of each forewing. The hindwings are white and both the pairs are fringed with hairs. A female lays 36 to 76 minute broadly oval, greenish yellow shining eggs usually near the midrib of the tender leaf in an oviposition period of 2 to 6 days. The eggs hatch in about 2–10 days and the lervae on hatching enter the leaf tissue and feed in mines. The larval stage lasts 5–20 days. The full grown larva (4th instar) curls edge of the mined leaf and pupates. The pupal period varies from 6-22 days. The insect has 9 to 13 generations in a year.

Weekly spraying of monocrotophos (0.035%) during flushing periods has been found highly satisfactory for the control of this pest.

Fig. 13. Citrus butterfly caterpillar

7. Citrus butterfly (*Papilio demoleus* (L.)) (Fig. 13) : The adults of *P. demoleus* are large beautiful butterflies. The black front wings are ornamented with numerous yellow spots and towards the inner margin of the hind wings a brick red oval patch is present. The female deposits 75 to 120 greyish yellow eggs singly on the underside of tender leaves. The eggs hatch in about 3–8 days. The young caterpillar is brownish to black in colour with white spots and when resting looks like a bird-dropping. The caterpillars become full fed in 13 to 26 days and are green in colour with few oblique, brownish stripes down the sides The pupae are straw coloured or green and mottled with black. Pupal period lasts about 7 to 24 days and in winter it may prolong from 12 to 20 weeks. Duration of life cycle varies from 18 to 24 days but during winter months extend upto about 145 days. There are several overlapping generations. The life-history and behaviour of other butterflies are almost similar to *P. demoleus*.

Methyl parathion (0.05%) and methamidophos (0.05%) have proved most persistent and effective insecticides for the control of *P. demoleus* caterpillars.

In addition to this butterfly a number of other leaf-feeding lepidopterous pests have been recorded on citrus which can also be checked by the measures adopted for the control of citrus butterfly.

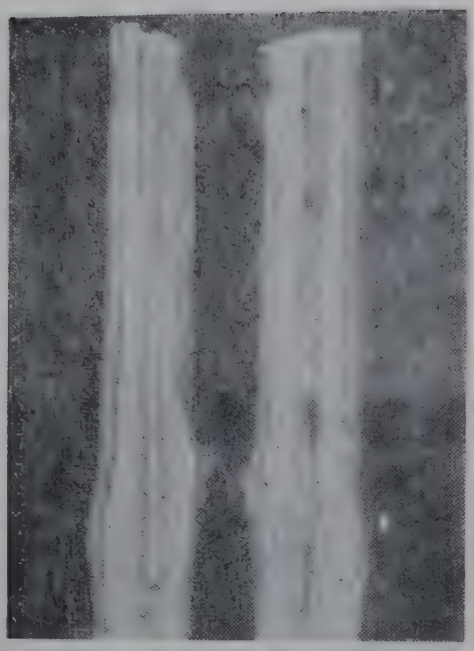


Fig. 14. Orange shoot borer

8. Orange shoot borer (*Oberea lateapicalis* Pic.) (Fig.14): The adult of the top shoot borer is slender brown insect measuring about 2 cm in length with eyes, antennae, tip of the abdomen and about $\frac{3}{4}$ of the front wings black in colour. It makes its appearance in March. The pest prefers citrus orchard intercropped with coffee than pure crop. In the mixed plantation, generally the temperature is low and the humidity high (due to shade). Such conditions appear to be congenial for the development of the pest. The eggs are laid on the skin of young flushes and the oviposition continues upto May–June. After laying an egg, the female girdles the shoot and the grub on hatching bores down where it feeds and pupates. There is only one annual generation. The multiplication of orange shoot borer can be checked by spraying with methyl parathion (0.05%) or monocrotophos (0.05%) or endosulfan (0.05%) or carbaryl (0.2%) at 10 days interval during the ovipositional period (middle of April to June). Apart from spraying, withered shoots should also be detected early and pruned about 4 cms below the dried portion.

Fig. 15. Damage caused by orange stem borer.

9. Orange stem borer (*Chelidonium argentatum* (Dalm.)) Fig. 15) : The adult is shining steel-blue beetle measuring about 3 cm in length. The eggs are deposited in June–July on young branches which hatch in 10–12 days. The grub on hatching bores into the pith and first moves towards the end of the branch. After about 2–6 weeks they reverse the direction, enter the thicker branches below and eventually make their way into the trunk where they continue feeding for rest of the life and pupate in the tunnel. While feeding the grubs eject frass from the holes. Pupal period lasts about three to four weeks. The adult beetles come out of their hidings when the rainy season starts. The best control of this pest can be achieved if a campaign is organized from end of July to September to prune all the branches containing grubs before they enter into the trunk. However, if the grub enters the trunk, injection of 15 to 20 ml. petrol in each live borer hole in the main trunk and plugging with wet clay gives higly effective control.

10. Oriental fruit fly (*Dacus dorsalis* Hendel): The incidence of oriental fruit fly was noticed in a number of private intercropped (citrus+coffee) orchards. The damage done by fruit fly is typical. Due to abortive stinging and ovipositional punctures, fungal and bacterial infections take place and fruits start rotting. In mature fruits the maggots multiply and such fruits usually drop down. The development of fruit fly is favoured by wet weather.

The adults are dark brown with transparent wings and yellow legs. The female inserts 2 to 15 eggs into the rind of semiripe fruits. About 200 eggs are laid in a period of one month. The eggs hatch in about 2 to 3 days in hot months and 10 days in winter. The maggots develop in the pulp and become full grown in 6 to 29 days. Pupation takes place 3 to 7 inches deep in the soil and the adults emerge after about 6 to 44 days in different seasons.

The control of fruit fly is achieved by applying bait spray containing malathion or trichlorfon or fenthion 0.05%+1% crude sugar. In areas of severe infestation, first spraying should be started about 60 days before the ripening of fruits and subsequent sprayings can be repeated at weekly intervals and at the same time all fallen fruits should be collected regularly and buried deep. Male annihilation technique using bait traps containing 0.1% methyl eugenol and 0.05% malathion can also reduce the pest population. Twentyfive such traps are kept per hectare starting 60 days before the fruit harvest and the solution should be changed at weekly intervals till the fruit harvest is completed.

11. Red spider mite (*Tetranychus fijiensis* Hirst.): This mite usually feeds on the under surface of leaves. It produces profuse webbing. The average life duration of female is about 30 days during which it produces about 80 to 110 eggs on the lowerside of leaves. Incubation period lasts for 3 to 5 days. The developmental stages require 4 to 8 days. The total life cycle is completed in 8 to 15 days. In Kodagu, Trifoliates and Citranges have been found worst affected by this mite. Red spider mite is effectively controlled by monocrotophos (0.05%) or dicofol (0.05%) or acarathane (0.05%) with two sprays at an interval of 10 days.

12. Oriental red mite (*Eutetranychus orientalis* (Klein.)): Feeding by this mite on the upper leaf surface produces a multitude of grey spots with gives a chlorotic appearance to leaves. Infested leaves become weak and finally drop. Females lay upto 8 eggs per day. Eggs are deposited mainly along with midrib on the upper surface of leaves. The pre-ovipositional period and longevity of adults vary from 1 to 8 and 12 to 18 days respectively, depending upon the weather conditions. The life history and behaviour of *E. banksi* are more or less similar to *E. orientalis*. For the control of oriental red mite, dicofol (0.05%) or monocrotophos (0.025%) or oxydemeton methyl (0.025%) have proved highly effective.

Brevipalpus sp. on citrus is also controlled by the measures taken for the control of other citrus mites.

13. Other pests : Citrus psylla (*Diaphorina citri* Kuwayama) can be controlled by sprays of oxydemeton methyl (0.025%) or monocrotophos (0.025%).

For the control of fruit sucking moths (*Othereis materna* L., *O. fullonica* (L.), *Achoea janata* (L.), *Calpe emarginata* Fb. and others) the following measures can be adopted : (1) Preventing the moths from approaching the fruits by smokes or by spraying crude oil emulsion and fish oil soap mixtures or bagging the fruits with 300 gauge alkathene or polythene bags with punctures on the bottom ; (2) Collecting adult moths by light traps, sugaring or by keeping out pieces of fruits near tree basin for attracting the sluggish moths in the evening with hand net and killing them ; (3) Destruction or eradication of alternate hosts ; (4) Baiting with malathion 0.05% + 1% crude sugar alongwith some vinegar or fruit juice.

Bark eating caterpillar (*Indarbela tetraonis* (M.)) can be controlled by inserting kerosene soaked cotton wads into their holes and closing them with wet clay. Removing the web and painting with BHC 0.5% can also give satisfactory results. The severely affected branches should be pruned out.

In addition to above mentioned pests, white ants (*Odontotermes obesus* R.), white grubs (*Holotricha* sp.), cutworms (*Agrotis segetum* Schiff.), bark lice (*Archipsocus* sp.), red tree ant (*Oecophylla smaragdina* Fb.), Thrips (*Thrips hawaiiensis* (Morg.)) and *Haplothrips ganglbaueri* (Schm.)) gall midge (*Dasyneura citri* Gl. & Pras.), *Rhynchocoris humeralis* (Thumb.), *Vitellus orientalis* Dist., *Coppoea autennatus* K., *Preys endocarpa* Meyr., *Dichocrosis punctiferalis* (Gn.) and psychid have also been recorded causing damage to citrus plantations.

BIOLOGICAL CONTROL OF MEALYBUGS ON CITRUS AND OTHER HOSTS

Mealybugs are serious pests of citrus and coffee. They prefer to feed on the stalks of fruits or berries resulting in their drop. The losses caused by these insects are tremendous. For the control of mealybugs mostly chemical control measures are recommended. The insecticides used, however, do not always give desired results. Moreover, the use of highly toxic persistent insecticides reduces the population of natural enemies of mealybugs At the Horticultural Experiment Station, Chethalli, a simple mass propagation technique was standardized for mass multiplication of a potential mealybug predator, *Cryptolaemus montrouzieri*. Mulsant, to control mealybugs (*Planococcus* and *Pseudococcus* spp.) on citrus.

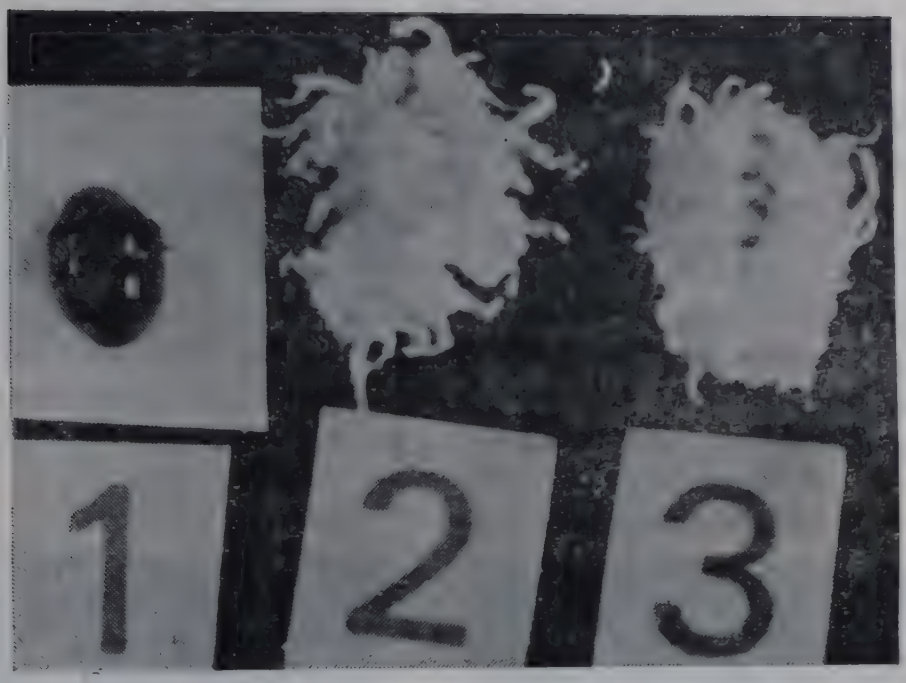


Fig. 16. Adult beetle; 2. Grub; 3. Pupa.

During 1977, an insectary (Fig. 17) was established at this station for propagation of this beetle. Ever since the commissioning of this insectary, experiments have been extended and thousands of beetles have been released in mixed planted orchards throughout the district. It may be mentioned here that in this district about 99 per cent of the orchards are mixed plantations (citrus and coffee). Almost all subsequent releases were made in such orchards to control the mealybugs on citrus as well as coffee.

Fig. 17. Part of the inside view of the insectary.

PROPAGATION TECHNIQUE

The propagation of citrus mealybugs is carried out on ripe pumpkins. The pumpkins are selected with ridges and grooves with a small stalk which makes the handling easy. To prevent rotting, the pumpkins are treated with 0.1 percent (one g/lit.) Benlate. Pure culture of citrus mealybug is maintained in the infestation room and the crawlers (1st instar mealybugs) emerging from this culture are dusted (released) on the upper side of the pumpkin which is kept on a plastic pumpkin-stand inside the cage. In due course of time the crawlers settle on all sides of the pumpkin and develop into fully mature mealybugs (Fig. 18) within a period of 30 or 40 days. The mealybug infested pumpkin is exposed to beetles (Fig.19) for a period of 24 hours anytime after 15 days of the initial infestation of

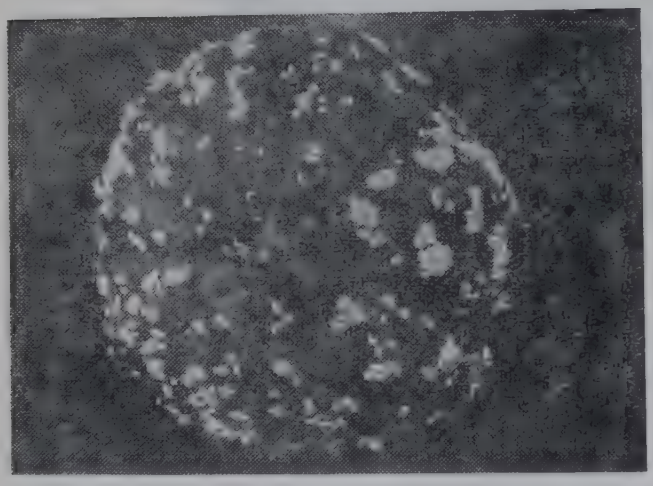


Fig. 18. Pumpkin infested with mealybugs.

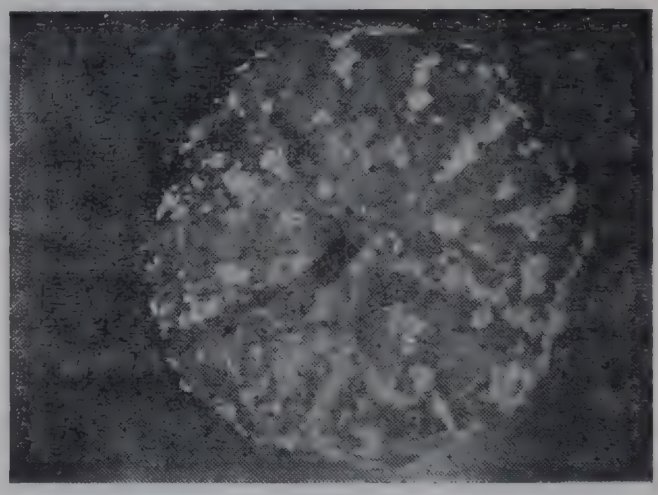
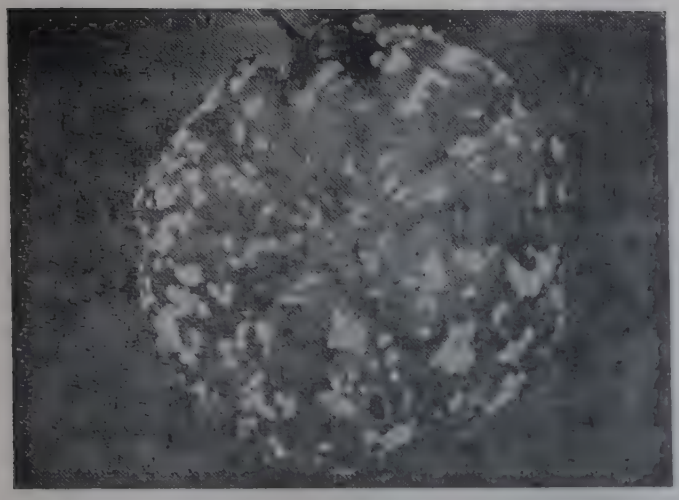


Fig. 19. Mealybug infested pumpkin exposed to beetles.

crawlers. The culture of adult beetles is maintained in the breeding cage (about 100 beetles/cage). These beetles are used for a period of about 15 days after which they are released in the field. The mealybug infested pumpkin after exposure to beetles is again kept back in the original cage where the breeding continues. At the bottom of the breeding cages some dried leaves are kept to facilitate pupation of the grubs.

The beetles lay their eggs singly or in groups of 4–12 in the ovisacs of feamale mealybugs. If the females are not fully developed the eggs are laid anywhere near the mealybugs. The grubs are visible in about a week's time. Initially they feed on the eggs of mealybugs and as they grow in size (Fig. 20) they start feeding on mealybug adults and nymphs. When full fed the grubs of the last (4th) instar pupate in the leaves or any where inside the breeding cage. The pupa is located in the exuvia of the last instar grub.



The first beetle from this breeding cage emerges in 30 days time from the date of exposure to beetles. The beetles continue emerging in fairly large numbers for a period of 10–20 days and are collected daily and kept in breeding cage for mating. Beetles (after mating) are taken regularly for experimental releases in the mealybug infested areas. Each breeding cage yields 100 to 200 beetles.

Fig. 20. Grubs of *Cryptolaemus* feeding on mealybugs.

PROCEDURE FOR FIELD RELEASE

For this purpose the adult beetles are packed according to requirement in perforated polyethylene bags with the help of rubber bands. The beetles in bags are kept overnight and released the next day. Perforated bread boxes can also be used.

Based on the experiments conducted at this station the following procedure should be followed before the first release of the predator is made :

1. Mark the mealybug infested plants early in the season.

2. Put a band of diazinon 5 per cent granules ground the trunk of the plant leaving about one foot from the main stem. All other ant control methods should be followed such as destruction of ant-holes, red ant nests and skirting of citrus trees after fruit harvest which prevents the ant migration through side branches. (*Failure to control ants may prove detrimental to biological control programme.*)

3. Once the patrolling (up and down) of ants on the trunk is stopped, the beetles can be released. In bearing mixed planted orchards the number of beetles (per plant) should be released as follows :

Coorg mandarin	= 10
Robusta coffee	= 5
Arabica coffee	= 3
San-ramon	= 2

4. Periodic check should be made for the first fortnight and after about twenty days from the release date, dried leaf mulch should be put around the stem or trunk of the plant to facilitate pupation, as the full fed grubs usually seek pupation sites near the base of the plant.

If the releases are made early in the season and the first generation beetles develop from the released beetles, the second generation definitely brings the mealybug population to a negligible level.

One to three releases are required annually in areas with fairly high mealybug populations.

Vegetable Crops

BHENDI (OKRA)

Shoot and fruit borer (*Earias* spp.)

Description: The moth *Earias vittella* Fabr. has an yellowish head and thorax. Its forewings are pale white and have a broad, wedge shaped, greenish band in the middle. It measures about 9.5 mm long and 19 to 24 mm across the wings. Another allied species *Earias insulana* Boisd., is characterised by completely green forewings and wing expanse is about 25 mm. The Caterpillars of both the species are brownish white and have a dark head and a prothoracic shield. They have a number of black and brown spots on the body and hence the name spotted bollworms.

Nature of damage: Caterpillars bore into tender shoots, flower buds and fruits. As a result the attacked shoots dry up while flowers, buds and developing fruits drop down prematurely. Affected fruits remaining on the plant become unfit for human consumption. About 35 per cent fruits are damaged by the pest. It also attacks cotton, ambadi, *Hibiscus* flowers and other malvaceous plants. Fruit borer damage is severe in summer season, moderate in June and negligible in August sown crop around Bangalore area.

Fig. 21. Shoot borer damage

Fig. 22. Fruit borer damage
(L) Infested fruits (R) Healthy fruits

Distribution : This pest is widely distributed and is reported from Uttar Pradesh, Delhi, Punjab, Bihar, Gujarat, Maharashtra, Madhya Pradesh, Tamil Nadu, Karnataka, Kerala and Andhra Pradesh.

Control : Remove and destroy the infested shoots, fruits and shed material. Spray carbaryl 0.1 (Sevin or Kilex Carbaryl 50% W.P. at 2 gm per litre of water) at weekly intervals from the first set during fruiting season. It is safe to harvest the crop 2 days after spraying. Pest damage during vegetative stage can be effectively controlled by spraying monocrotophos 0.05% (i.e., 1.25 ml of Nuvacron 40 E.C. or 2 ml of Azodrin 24 E.C. per litre of water).

Jassids (*Amrasca biguttula biguttula* Ishida)

Description : The adult is wedge-shaped, about 2 mm long and pale green in colour. Its forewings have a black spot on the posterior parts. The nymphs are wingless,

pale green in colour and are found in large numbers on the lower surface of the leaves. The adults and nymphs have a characteristic way of walking diagonally in relation to their body.

Nature of damage : Nymph and adult populations suck the sap from leaf tissues mostly from the undersurface of the leaf. The affected leaves curl upwards along the tips and margins and develop necrotic areas which extend to entire leaf surface resulting in drying up of the leaves. This pest also attacks brinjal, potato and cotton. The pest attack is severe during April to August around Bangalore.

Fig. 23. Jassid damage
A. Infested plant
B. Healthy plant

Distribution : The pest is widely distributed in all the Cotton and Bhendi growing areas of Punjab, Tamil Nadu, Maharashtra. Karnataka, Bihar, Andhra Pradesh and Uttar Pradesh.

Control : Apply granules of disulfoton (Disyston or Solvirex 5 G at 10 kg/ha) or carbofuran (Furadan 3 G at 16 kg/ha) at the time of sowing or spray dimethoate (Rogor 30 E.C. 1.5 ml/litre) or monocrotophos (Nuvacron 40 E.C. at 1 ml/litre or Azodrin 24 E.C. at 1.8 ml/litre) at the appearance of the insect population. Carbaryl sprays taken up during fruiting season also control the jassids.

Aphids (*Aphis gosspyii* Glov.)

Description : The adults are yellowish to dark green or black in colour and are about 1.25 mm in length. They have two tubes which are called cornicles in the posterior half of the abdomen. The adults are mostly wingless but later in the season at the maturity of the crop, winged adults are also found. Their wings are transparent sometimes with black lines on them. The nymphs are green to brown in colour.

Nature of damage : Aphids are usually noticed on the underside of the leaf but when their population is high they are also seen on all the tender parts of the plant viz., shoot, flower buds, etc. Nymphs and adults suck the sap from the plant and reduce the vigour. In case of severe incidence the plants become stunted and the yield is drastically reduced. They also excrete a large amount of sweet and sticky substance called honey-dew which comes to lie on the leaf surface, giving a good medium for a characteristic black fungus to grow. The presence of excessive amount of mould interferes with the photo-synthetic process of the plant.

Fig. 24. Aphid infestation

Distribution : It is widely distributed and found in all Bhendi growing are as of our country.

Control : Spray dimethoate (Rogor or kilex dimethoate at 1 ml/litre) or monocro tophos (Nuvacron 1 ml/litre of Azodrin 18 ml/10 litres) at the time of appearance of the aphid colonies and repeat at fortnightly intervals, if necessary.

Red spider mites (*Tetranychus* spp.)

Description : The adult males average about 383 microns by 187 microns. They bear fourteen pairs of dorsai body setae. They are active and crawl over the leaf surface in search of female deutonymphs that are nearing emergence as adults. The adult female averages 521 microns long by 304 microns wide and bears thirteen pairs of dorsal setae. The males and females usually survive from 3 to 9 days and 8 to 14 days respectively.

Nature of damage : Immature and adult mites which are pale and reddish, suck the sap from under surface of the leaf and tender parts and produce characteristic pale speckles. With rise in mite population, speckles coalesce giving rise to wider blotches and in case of severe infestation leaves shed down prematurely.

Distribution : They are reported from all the Bhendi growing areas of our country viz., Punjab, Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, and Madhya Pradesh. Besides Bhendi they also infest brinjal, beans, gourds and melons.

Control : Spray tetradifon (Tedion at 3 ml/litre) or chlordimeform (Galecron at 13 ml/10 litres) or dimethoate (Rogor at 1 ml/litre) or dicofol (Kelthane 1.5 ml/litre) of water.

Root knot nematodes (*Meloidogyne* spp.)

Nature of damage : The infested plants are stunted with galls found scattered on roots. There is a marked reduction in root growth, shoot weight and fruit yield.

Distribution : The nematode is distributed throughout India.

Fig. 25. Bhendi root damage by nematodes.
(L) Healthy roots (R) Infested roots

Control : Pre-plant application of aldicarb (Temik 10 G at 10 kg/ha) or carbofuran (Furadan 3 G at 33 kg/ha) or fensulfothion (Dasanit 5 G at 20 kg/ha) in planting rows controls root knot nematodes and increases the fruit yield. Harvesting okra fruits 50 days after sowing was found safe for consumption.

BRINJAL

Shoot and fruit borer (*Leucinodes orbonalis* Guen.)

Description : The moths measure about 10 mm in length, a little over 20 mm wing-span and are medium sized, having whitish wings with large brown patches all over. The head and thorax are blackish brown. The caterpillars are pinkish, smooth, almost hairless, about 13 mm long when full-grown.

Nature of damage : During vegetative stage the caterpillar bores into the shoots, petioles and midrib of large leaves resulting in withering of terminal portion. Later during fruiting, the larvae enter the young fruits through calyx and feed therein rendering them unfit for consumption. The large holes seen on the fruits are usually the exit holes of the caterpillars. The pest is more serious in rainy season than in summer season.

901
COMMUNITY HEALTH CELL
St. Marks Road,

Fig. 26. Shoot borer damage

COMMUNITY HEALTH CELL
326, V Main, I Block
Koramangala
Bangalore-560034
India

Fig. 27. Fruit borer damage

Distribution : It is a cosmopolitan insect and is reported from Tamil Nadu, West Bengal, Maharashtra, Andhra Pradesh, Bihar, Uttar Pradesh and other brinjal growing areas of the country.

Control : Removal and destruction of the affected shoots and fruits along with the caterpillars helps in reducing the intensity of infestation. Spray carbaryl (Sevin 50% W.P. at 2 gm/litre) or fenvalerate (Sumicidin 20 E.C. at 0.5 ml/litre) or permethrin 10 E.C. at 1 ml/litre at fortnightly intervals commencing from the first fruit set. Observe 5 days gap between spraying and harvesting of fruits. For the control of shoot borer damage during vegetative stage, sprays of quinalphos (Ekalux 25% E.C. at 2 ml per litre of water) or chlorfenvinphos (Birlane 24% E.C. at 2 ml per litre of water) can be applied alternatively to carbaryl sprays (i.e., Sevin 50% W.P. at 2 gm per litre of water).

Epilachna beetles (*Epilachna* spp.)

The adult beetles are spherical, pale brown and mottled with black spots. There are two species one having 12 spots, *Epilachna 12-stigma* and another having as many as 28 spots, *Epilachna 28-punctata*. The grubs are yellowish in colour and stout bodied, with stout hair on their bodies.

Nature of damage : Grubs and adult beetles cause serious damage to brinjal and potato by feeding on the chlorophyll of the leaves in between the veins which results in characterstic skeletonized patches on leaves. The beetles also feed on tomato, pumpkin, bittergourd, cowpea and some solanaceous medicinal plants.

Fig. 28. Leaf damage by epilachna beetle

Distribution : It is widely distributed and reported from many parts of our country viz., Delhi, Maharashtra, Andhra Pradesh, West Bengal, Karnataka, Uttar Pradesh, Bihar and Tamil Nadu.

Control : In kitchen gardens the pest attack can be checked by the removal of yellowish egg masses and by shaking of the adult beetles in a pail of kerosenized water in the early mornings. Spray carbaryl (Sevin 50% W.P. at 3 gms/litre) or malathion (Cythion 50% E.C. at 2 ml/litre) or trichlorphon (Dipterex 50 % E.C. at 2 ml/litre).

Root knot nematodes (*Meloidogyne* spp.)

Nature of damage : The infected plants are stunted with galls found scattered on roots. There is a marked reduction in root and shoot growth and fruit yield.

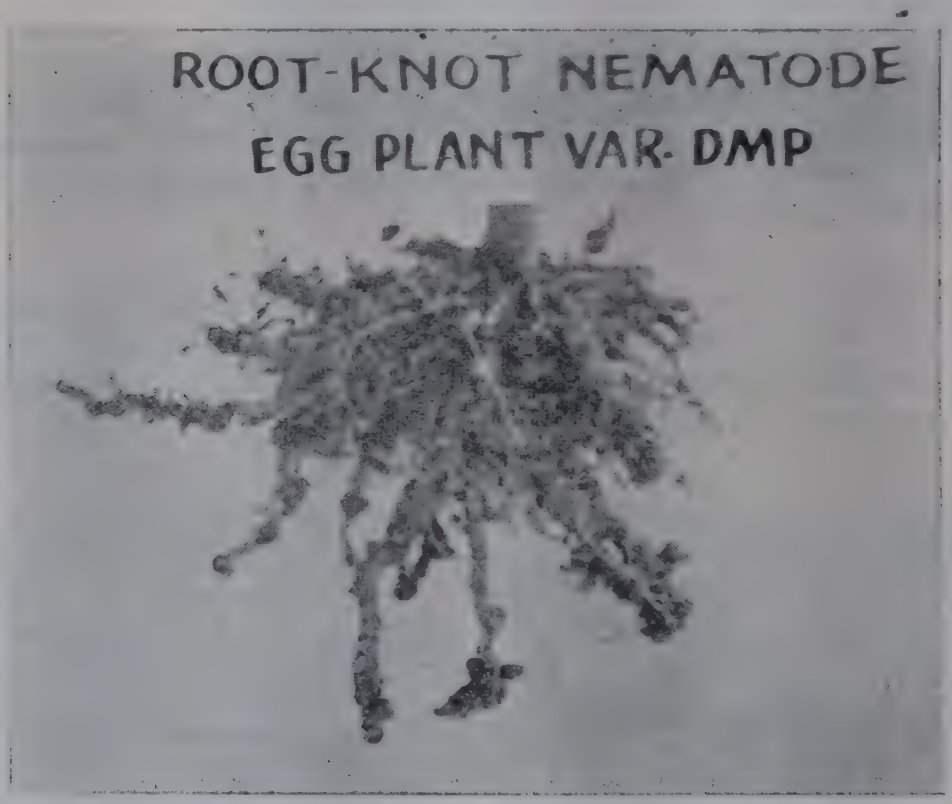


Fig. 29. Damage by root knot nematodes

Distribution : The nematode is distributed throughout India.

Control : Pre-plant application of carbofuran (Furadan 3 G at 33 kg/ha) or aldicarb (Temik 10 G at 10 kg/ha) in planting holes controls the root-knot nematodes and increases fruit yield.

TOMATO

Fruit borer (*Heliothis armigera* Hub.)

Description : The moths are stout, pale brown or light yellowish brown, with a wing expanse of 40 mm. The forewings are pale brown with some black dots, and the hindwings are lighter in colour with smoky dark margins. The caterpillars are greenish and with dark broken grey lines along the sides of the body and measure 40 to 50 mm in length when full-grown.

Nature of damage : Young larvae feed on tender foliage, later enter the fruits and feed therein, Young fruits shrivel and fall down while the later attacked fruits are rendered unmarketable. About 35% yield reduction has been observed due to this pest. It has been found attacking the crop all round the year. The pest attacks most of the other vegetable crops, the seriously affected crops being peas, french beans, cowpea and okra.

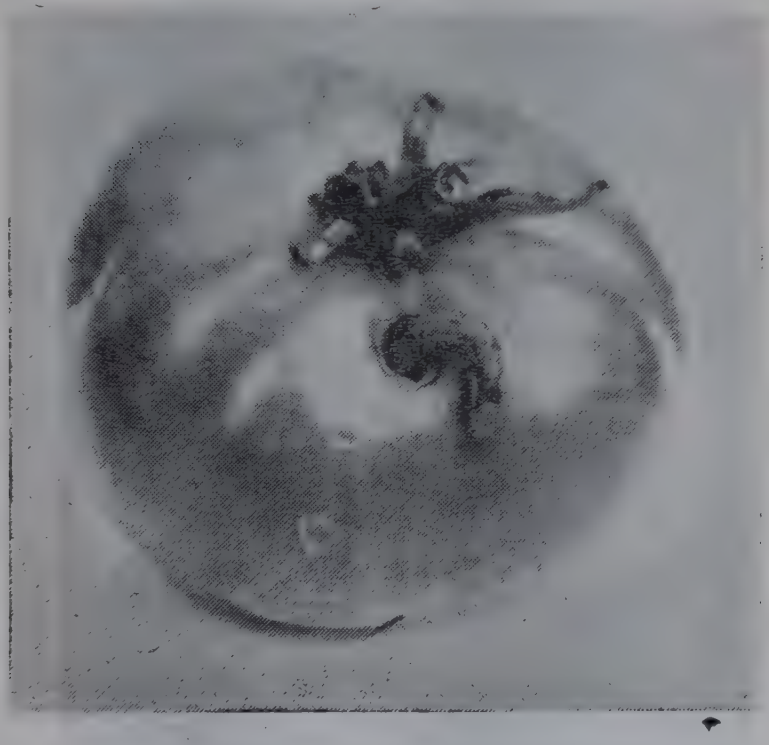


Fig. 30. Damage by tomato fruit borer

Distribution : It is reported from Tamil Nadu, Uttar Pradesh, Andhra Pradesh, Bihar, Karnataka and many other parts of our country.

Control : Spray methomyl (Lannate 20 L at 25 ml/10 litres of water) of malathion (Cythion 50% E.C. at 2 ml/litre of water) or carbaryl (Sevin 50% W.P. at 3 gms/litre of water) at fortnightly intervals commencing from the first fruit set. Do not apply these insecticides within 4 days prior to harvest. Destruction of infested fruits along with the caterpillars reduces the pest infestation.

CABBAGE AND CAULIFLOWER

Aphids :

Description : Aphid species (*Brevicoryne brassicae* Linn., *Lipaphis erysimi* Kalt., and *Myzus persicae* Sulz.) attack the crop. The yellowish green and soft aphids are usually 2. 5 to 3 mm long. They are not active but remain stationary engaged in sucking the sap. The body is oblong in shape and young nymphs have dorsal setae on a few segments of thorax and abdomen. Two short tubes that are known as cornicles or honey tubes, project from the upper surface of the hind end of the body in the nymphs and adults. A number of commensals specially ants are found in association with these insects, as they are attracted to honey dew excreted by aphids and in return the ants give protection. Antennae are short and six jointed. Generally apterous forms occur, but winged forms are produced at the maturity of the crop, when they have to migrate. Wings are transparent and veins are distinct.

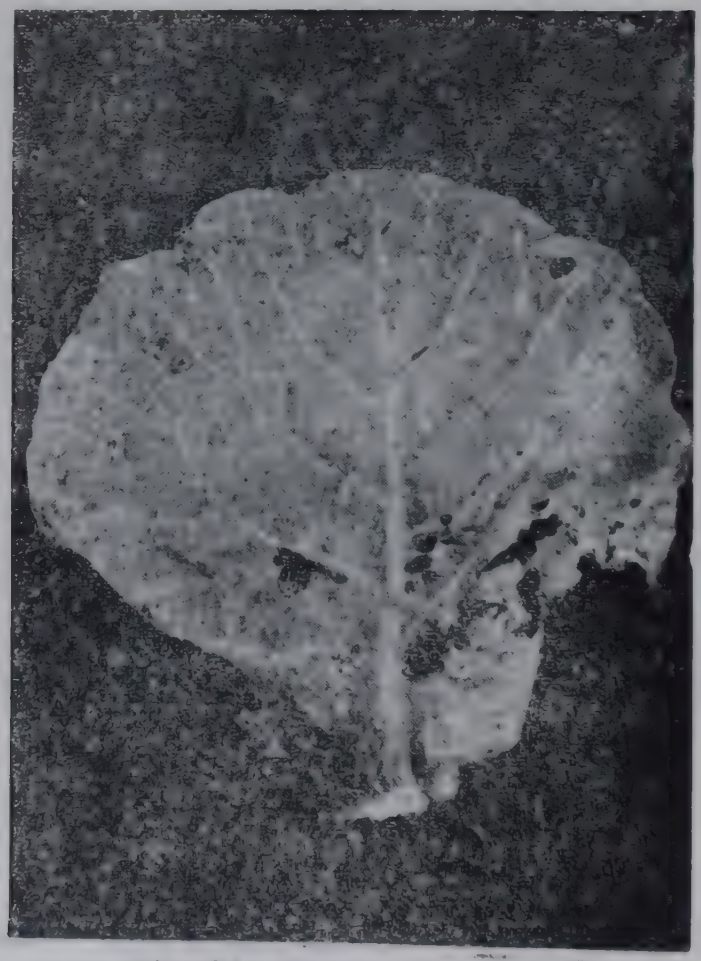


Fig. 31. Damage by aphids

Nature of damage : The aphids suck the sap and reduce the vigour of the plant. In cabbage the aphids get into the inner leaves of the head and in cauliflower all the inner-spaces in the head are filled by aphids thus making the vegetables unmarketable. In flowering plants the growing points of the main shoots and their branches are killed and owing to very heavy infestation the growth of the cabbage plants is greatly arrested. Compared to cabbage, flowering plants of radish and mustard turn pale and succumb quickly. These aphids also attack other cruciferous crops viz., knol khol and turnip.

Distribution : The aphids are widely distributed and are reported from Punjab, West Bengal, Delhi, Bihar, Karnataka and Uttar Pradesh.

Control : The aphids can be controlled by the sprays of dimethoate (Rogor 30 E.C. at 1 ml per litre of water) or monocrotophos (Nuvacron 40 E.C. at 1 ml per litre of water) or quinalphos (Ekalux 25 E.C. at 2 ml per litre of water). Observe 1 week interval for dimethoate and 2 weeks for monocrotophos and quinalphos between spraying and harvest.

Diamond back moth (*Plutella xylostella* Linn.)

Description : The small grayish moths spend the winter hidden under the remnants of the cabbage crop left in the field. They are about 8 mm long, the folded wings flaring outward and upward toward their tips and in the male, forming a row of three diamond-shaped yellow spots where they meet down the middle of the back. The posterior wings have a fringe of long hairs.

Nature of damage : Very small greenish caterpillars eat on the under surface of the leaves, making many small holes, giving a shot-hole appearance all over the leaves. In dry season they sometimes become abundant enough to cause appreciable injury to young cabbage. They rarely exceed 1 cm in length, are pale yellowish green in colour with fine scattered erect black hairs over the body and become full-grown in about 10 to 30 days. They can be distinguished from other caterpillars by their nervous habit of wriggling activity when disturbed or dropping down on a silken thread. This pest is also observed on mustard, rape and many other cruciferous plants.

Distribution : This pest is widely distributed and is reported from Punjab, West Bengal, Delhi, Uttar Pradesh and Karnataka.

Control : This pest can be controlled by spraying malathion 0.1% (Cythion 50 E.C. 2 ml/litre), quinalphos 0.05% (Ekalux 25 E.C. 2ml/litre) or methamidophos 0.05% (Tamaron 50 E.C. 1 ml/litre). Observe 4 days gap in case of malathion and 2 weeks gap for quinalphos and methamidophos between spraying and harvesting of heads. Remove the outer cabbage leaves before consuming the heads.

Fig. 32. Damage by diamond back moth larvae

Fig. 33. Damage by Cabbage leaf webber

Leaf webber (*Crocidolomia binotalis* Zell.)

Nature of damage : The caterpillars of the cabbage leaf webber spin a web on the lower surface of the leaves and feed under its cover on the leaf tissue. It has been observed that the pest sometimes causes a good deal of damage by webbing a large number of leaves and occasionally boring into the primordium as well.

Control : Same as given for diamond back moth.

Stemborer (*Hellula undalis* Fabr.)

Nature of damage : The adult is pale yellowish brown with wavy gray markings on the wings. The newly hatched caterpillars mine into the leaves and later prepare covered passages made of silk and excerement and ultimately bore into the stem causing the death of the plants.

Control : They can be destroyed by picking in the early stages of the crop when their population is small. Other measures are the same as given for diamond back moth.

BEANS, PEAS AND COWPEA

Stemfly (*Melanagromyza phaseoli* Tryon)

Description : The adult is metallic black. The eyes are light brown, the wings are hyaline and there is a distinct notch in the costal ragion. The average measurement of the fly is 2.07 mm × 4.97 mm including the wing expanse. The female is slightly bigger than the male.

Nature of damage : Immature stages of the fly (maggots) feed on the outer layers of the stem of the young plants at the collar region resulting in the death of the plants. The adult females also damage the leaves by puncturing them. The punctured leaves droop down and dry up. This process takes 10 to 12 days, by which time the maggot pupates. In acute cases of infestation the larval gallery in the basal portion of the stem turns rusty and is filled with frass. Early sown peas are more susceptible than late sown crop. The maggot also attacks cowpea and creeper beans.

Distribution : It is widely distributed and reported from Uttar Pradesh, Bihar, Punjab, Karnataka and other states where peas are grown.

Control : In the areas of regular occurrence of this pest, spray dimethoate (Rogor at 1 ml/litre) twice at weekly intervals from the time of complete germination.

Pea aphid (*Acyrthosiphon pisum* Harris)

Description : The small pale green insects measure about 4 mm in length. They have long legs, cauda and cornicles. Antennae are also long. The terminal shoot, leaves and the branches may be found covered with myriads of winged and wingless aphids.

Nature of damage : Aphids suck the sap of the plant and possibly also inject toxins into the plant. When the aphids are abundant, their shed skins give the plants and ground a whitish appearance. When the infestation is severe it may kill the plants or at least reduce the yield drastically, besides affecting the quality.

Fig. 34. Damage by pea aphids

Distribution : It is widely distributed and is reported from Uttar Pradesh Bihar Punjab and Karnataka.

Control : The aphids can be successfully controlled by dimethoate (Rogor at 1 ml/ litre of water) sprays. Alternatively carbofuran granules can be applied at 1.0 kg a.i/ha (Furadan 3 G 33 kg/ha) at the time of sowing.

Pod borers (*Adisura atkinsoni* Moore, *Heliothis armigera* Hub. etc.)

Fig. 35. Damage by pod borers

Control : Pod borers which damage the developing pods cand be controlled by carbaryl (Sevin 50% W.P. at 4 gms/litre), phenthoate (Phendal 50 E.C. at 1 ml/litre) or fenvalerate (Sumicidin 20 E.C. at 0.5 ml/litre) sprays.

ONION, CAPSICUM AND CHILLIES

Thrips (*Thrips tabaci* Lind. and *Scirtothrips dorsalis* Hood)

Description : The adult onion thrips are slender, yellow, active and pointed at both ends. The largest of them is only 1.2 mm long. The females have four extremely slender wings which have long fringe of very long hairs on their posterior margins. The male is similar to female except that it is smaller, lighter in colour and without a complete comb of setae on posterior margin of abdominal tergite viii. The male is very scarce. The feet are also remarkable with the tarsus ending in a small bladder.

Nature of damage : These minute insects lacerate plant tissues and suck the sap from the leaves forming white blotches in case of onion and curly leaves with stunted plant look in capsicum. In case of severe infestation the entire crop gives whitish appearance with drying tips and thin leaves in onion.

Distribution : The pest is reported from Delhi, Tamil Nadu, Maharashtra, Bihar, Uttar Pradesh, Andhra Pradesh and Karnataka.

Control : Spray malathion (Cythion 50 E.C. at 1.5 ml per litre) or dimethoate (Rogor 30 E.C. at 1 ml/litre) or monocrotophos (Nuvacron 40 E.C. at 1 ml/litre) of water.

CUCURBITS (GOURDS, PUMPKIN, MELONS etc.)

Red pumpkin beetle (*Raphidopalpa foveicollis* Lucas)

Description : The beetle is active, brilliant orange-red coloured, about 7 mm long and about 2.6 mm broad. The body has a very shining dorsal smooth surface and its underside is entirely black and covered with short white soft hair like setae. The grub is small yellowish white with a brownish head and when full-grown measures about 12 mm in length.

Nature of damage : The adult beetles feed voraciously on foliage and are destructive to seedlings often necessitating resowings. The grubs feed on the roots and stems below the ground. Damaged roots and stems rot due to infection by saprophytic fungus.

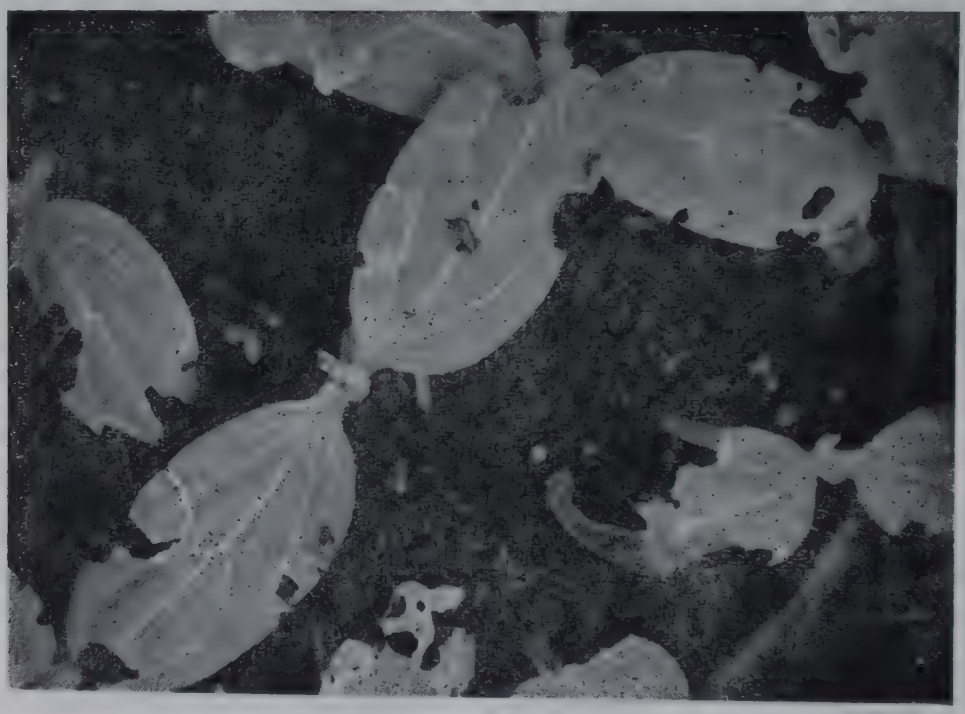


Fig. 36. Leaf damage of red pumpkin beetle

Distribution : The pest is reported from Gujarat, Tamil Nadu, Rajasthan, Bihar, West Bengal, Uttar Pradesh, Punjab and Karnataka.

Control : Grow a few scattered cucurbit plants in January and destroy the attracted beetles by foliar spray of carbaryl or malathion and their immature stages by treating the soil with insecticides like aldrin (Aldrin 5% dust at 25 kg/ha). Protect the seedlings by weekly sprays of malathion (Malathion 50% E.C. at 2 ml/litre) or carbaryl (Sevin 5% W.P. at 2 gms/litre).

Fruitfly (*Dacus cucurbitae* Coq.)

Description : It is a reddish brown fly with lemon yellow curved vertical markings on the thorax. The female fly is 5 mm long and the male is slightly smaller in length The abdomen of the female is conical ending in a pointed ovipositor while male has spherical abdomen. The wings are transparent, possess brown bands and grey spots at the apex. Halteres are distinct. The wings are fully stretched at the resting position and during the act of oviposition.

Fig. 37. Damage by fruitfly

Nature of damage : The pest attacks mostly at the early stage of the fruit development. Affected fruits mostly do not develop and those which develop become unfit for consumption as they contain maggots inside. Due to the attack of this pest fruits are also deformed.

Distribution : The pest is widely distributed and is reported from Gujarat, Tamil Nadu, Rajasthan, West Bengal, Uttar Pradesh, Bihar, Punjab, Karnataka and other regions of the country.

Control : Destroy the damaged fruits along with maggots. Spray carbaryl (Sevin 50% W.P. at 4 gms/litre) or malathion (Cythion 50% E.C. at 2 ml/litre) 2 to 3 times at ten day intervals from the time of flowering.

Root-knot nematodes (*Meloidogyne* spp.)

Nature of damage : The growth of pumpkin plants infected with root-knot nematodes is reduced with galls found scattered on roots. There is a marked reduction in root and shoot growth and fruit yield.

Distribution : The nematode is distributed throughout India.

Control : Pre-plant application of carbofuran (Furadan 3 G at 33 kg/ha) or fensulfothion (Dasanit 5 G at 20 kg/ha) or aldicarb (Temik 10 G at 10 kg/ha) in planting holes controls the root-knot nematodes and increases the yield.

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Fig. 38. Pumpkin root damage by nematodes
(L) Infected. (R) Healthy.

AMARANTHUS

Aphids (*Aphis craccivora*)

Aphids are usually noticed on the underside of the leaf but when their population is high they are also seen on all the tender parts of the plant viz., shoot and flower buds. Nymphs and adults suck the sap and reduce the vigour. In case of severe incidence the plants become stunted and the yield is drastically reduced. Spray malathion at 1 ml/litre at the time of appearance of the aphid colonies and repeat at fortnightly intervals, if necessary.

Caterpillars

Leaf eating caterpillars (*Hymenia recurvalis*), green semilooper (*Plusia eriosoma*) and Cutworm (*Spodoptera exiqua*) attack the plant throughout its growth feeding on the leaves and causing extensive defoliation. Control these pests by spraying malathion 0.1% (Malathion 50 EC at 2 ml/litre), or carbaryl 0.1% (Sevin 50% W.P. at 2 gms/litre). Observe 4 days gap between spraying and harvesting.

Inflorescence thrips (*Euryaplothrips crassus* and *Haplothrips ceylonicus*)

These minute insects lacerate plant tissues and suck the sap from the leaves forming curly leaves with stunted plant look. Spray malathion (Malathion 50 E.C. at 1.5 ml/litre).

Amaranthus weevils (*Hypolixus truncatulus* and *Ptochus Ovulum*)

The grubs feed on the roots of plants and cause large scale wilting and drying of plants. The adults feed on the leaves from the edges in a characteristic manner. When disturbed the adults fall to the ground and remain motionless. The adults can be controlled by fortnightly sprays of carbaryl (Sevin or Kilex carbaryl 50 W.P. at 2 gms/litre). Incorporating dust of chlordane or Heptachlor at 2 kg a.i./ha into the soil affords protection against grubs.

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